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FISKERIDIREKTORATETS SKRIFTER
Serie Havundersøkelser
(Reports on Norwegian Fishery and Marine Investigations)
Vol. IX. No. 9
Published by the Director of Fisheries

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By
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The Influence of the Environment on Number of Vertebrae in Plaice.

In Journal du Conseil Vol. XV No. 3, a description was given of the methods employed until the year 1946 for rearing pelagic salt water fishes at Flødevigen. The experiments have been continued with success in the following years under the responsibility of laboratory assistant S. HANSEN. The apparatus and methods employed will be dealt with in another paper. Although the experiments hitherto have been mainly technical, some of the results may be of interest to the biologists. I will here refer to some countings of vertebrae in the plaice.

In 1933, on counting the number of vertebrae of the O-group of coalfish (Alf Dannevig (1933)), there seemed to be some correlation between the length of the fish and the number of vertebrae. Later, the same phenomenon has been observed by several investigators in many other species. It is not always the case, however, since in other samples of the same species such a correlation does not exist. As to the spring spawners, the correlation between the length of the fish and the number of vertebrae is generally explained by saying that the smallest individuals are the result of a late spawning, i. e. a higher temperature during incubation, the temperature being assumed as the acting factor.

In 1948 we had a few spawning plaice living in an aquarium, and some of the eggs were collected, the larvae being hatched and reared together. At an age of 96 days 343 plaice were examined; the mean length of the fish arranged according to number of vertebrae is given in tab. 1.

Table 1.

	Number of vertebrae				
	40	41	42	43	44
Mean lenght in mm no. in ( ).	10.5 (2)	12.2 (13)	14.2 (200)	15.9 (118)	13.0 (1)

The difference in length between fish having 42 and 43 vertebrae, is statistically significant.

The length of the fish increases with the number of vertebrae. In this experiment the temperature can not have influenced the correlation between the number of vertebrae and the size of the fish. The divergences must be caused by some qualities of the eggs, but at present it is not possible to say what those qualities may be. They may be hereditary factors, or the size of the eggs (Alf Dannevig (1941)).

In 1949 the experiment was repeated, but this time the eggs were taken from one single female and fertilised with sperm from one single male. (For details of the parents and the progeny, see Tab. 3).

The length of the individuals arranged according to number of vertebrae, is given in table 2. In some cases we had accidents which resulted in some mortality. The samples of dead fish are marked with a *. — It is obvious that here we have no correlation between the number of vertebrae and the length of the individuals.

The results of the experiments in 1948 and 1949, when compared, indicate that the correlation found in 1948 must be ascribed to the heterogeneity of the material used. — It will not be safe, however, to discuss that problem till more experiments have been made.

The eggs used for the experiments nos. 3, 9 & 10 were secured from the same female and fertilised with sperms from the same male. The eggs in all experiments were hatched under the conditions prevailing in the laboratory, nos. 9 & 10 in the same aquarium, but separated during rearing. The salinity and the temperature have varied somewhat from day to day. The eggs in experiments nos. 9 & 10 are from the same batch, and the mean temperature during incubation was 5.41° C. The mean temperature during the hatching of experiment no. 3 was, however, 4.93° C. In no. 3 and no. 9 the larvae were reared under the temperatures prevailing in the laboratory, in no. 10, however, the water was heated a few degrees. In the table 3 B is given the mean temperature during the incubation and rearing period. As the water temperature increased during the course of the experiment, the mean temperature during rearing for each sample also rose. — The various samples from each experiment were taken from the same aquarium.

The results as to the number of vertebrae are given in table 3. It is evident that the number of vertebrae does not vary within the same experiment, whether the age of the larvae was 66 or 97 days. We may be sure therefore that the number of vertebrae had been settled even when the first samples were taken. This was also the case with the fin rays. The difference, in number of vertebrae, between the means of

experiments nos. 9 & 10, those hatched under the same temperature conditions, but reared at different temperatures, does not differ significantly. The number of vertebrae in experiment no. 3, the eggs here being hatched at a lower temperature, is approximately 0.4 higher. As to the number of rays in the dorsal fin, no significant variations took place. We may assume that the temperature during the time of incubation has been a factor of consequence to the number of vertebrae in the plaice, as has been stated previously by Johs. Schmidt and Tåning for the trout (Tåning (1944)). From the table it will be seen that the divergences are greater in the experiments hatched at the higher temperature. It will also be noticed that the number of vertebrae of the progeny in the experiment in which the eggs were hatched at a lower temperature, is in accordance with that of the parental fish.

As the temperature has not been kept constant, we are not able to say much about the critical stage when the number of vertebrae is settled.

The difference in increment of length between no. 9 and no. 10 is appreciable. The plaice reared in artificially heated water have grown very quickly, as will be seen from the data below. They were all fed in the same way, during the first weeks with Artemia, later with finely chopped Mytilus edulis.

	Age in days	Mean temp.	L mm
No. 9	81	6.21	13.3
No. 10	81	10.11	21.3
No. 9	162	10.43	37.2
No. 10	162	12.42	57.8

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Tabell 2. Length in mm of reared plaice arranged according to no. of vertebrae. Number in ( ). (-dead when fixed).*

Experiment	Number of vertebrae 38	39	40	41	42	43
No. 3. 1949						
10/5				11.3 (10)	10.9(193)	10.7 (7)
31/5*				11.4 (7)	11.4(86)	11.6 (7)
10/6			12.0 (2)	13.4 (16)	13.6(187)	13.8 (5)
No. 9						
18/5	14.0 (1)	13.4 (5)	13.7 (9)	13.1 (46)	13.3(141)	13.0 (8)
7/8		38.5 (2)	41.5 (12)	38.0 (31)	36.0 (56)	35.0 (1)
No. 10						
11/5—16/5* ..			13.3 (3)	12.7 (33)	13.6(52)	12.0 (2)
18/5		16.5 (2)	26.3 (7)	21.6 (66)	20.9(127)	20.5 (8)
18/6*			38.0 (5)	32.6 (30)	32.5(79)	38.0 (1)
28/7—7/8* ..		52.0 (1)	61.3 (3)	55.7 (37)	57.5(56)	55.0 (3)

Tab. 3. Plaice 1949. A. Parental fishes.

	L cm	No. of vertebrae	Rays Dorsal fin
♂	38	42	72
♀	44	42	71

B. The larvae reared.

Exp.	Mean Temp. inc.	rear.	Age days	N	38	39	40	41	42	43	$\bar{V}$
3.	4.93	5.97	66	210				10	193	7	41.99
		7.15	87	100				7	86	7	42.00
		7.59	97	210			2	16	187	5	41.93
				520			2	33	466	19	41.97
9.	5.41	6.21	81	210	1	5	9	46	141	8	41.64
		10.43	162	102		2	12	31	56	1	41.41
				312	1	7	21	77	197	9	41.57
10.	5.41	10.0	74—79	90			3	33	52	2	41.59
		10.11	81	210		2	7	66	127	8	41.63
		10.73	112	115			5	30	79	1	41.66
		12.42	152-162	100		1	3	37	56	3	41.57
				515		3	18	166	314	14	41.62

The difference in number of vertebrae between experiment no. 3 and nos. 9 & 10 is significant.